have a diameter ranging from, for example, about 10 cm to about 2 m. Suitable integrating spheres are commercially available from a number of manufacturers, for example, from Labsphere (North Sutton, N.H.) under the name Unisource 4000. The exit apertures **14**, **15**, **16** and inlet aperture **13** may have any suitable dimensions. For example, when the integrating sphere has a diameter of about 50 cm, each exit aperture may be a circular opening having a diameter of about 12 cm, and the inlet aperture may have a diameter ranging from about 1 cm to about 10 cm. Each of the apertures may be provided with a removable cap (not shown) to block radiation from exiting the sphere through the aperture.

The integrating sphere is placed in radiative communication with a radiation source, which preferably is a source of ultraviolet light. The invention is not limited to a particular source of ultraviolet light, and sources such as xenon lamps, mercury arc lamps, carbon arc lamps, globars, halogen lamps, lasers, fluorescent bulbs, metal halide lamps, tungsten-halogen lamps, and the like may be employed. The wattage may range from a few watts to 1,000 watts, 25,000 watts or more. In accordance with a preferred embodiment of the invention, the radiation source is an ultraviolet lamp manufactured by Orc Lighting Products under Model No. XM12000 WC or a 1,000 watt ultraviolet lamp sold by ILC.

To provide radiative communication between the radiation source and the integrating sphere, the radiation source may be placed directly within the integrating sphere, or may be disposed in an exit aperature. In a preferred embodiment, however, the radiation source is disposed externally with respect to intergrating sphere, as illustrated in FIGS. **1** and **10**. As illustrated in FIG. **10**, the apparatus may include a conduit **20** for transmitting light from a radiation source **19** to the interior cavity of the integrating sphere **11**. The conduit may be, for example, a fiber option connection. Alternatively, as shown in FIG. **1**, radiation from source **19'** may be directly introduced into the interior cavity **21**.

Typical sources of ultraviolet light generate light having a number of wavelength components, including not only the desired ultraviolet light component, but also several other undesired wavelengths of radiation. For example, the light source may generate visible and infrared light on the one hand, and ultraviolet light having a wavelength of below 290 nm on the other hand. The infrared and visible wavelengths often are undesirable because they may cause the temperature within the integrating sphere to increase to an undesirably high level. Elevated temperatures within the integrating sphere may cause the sphere to become warped or otherwise damaged. Moreover, although it may be desired to test the effects on a specimen of radiation in a thermally elevated environment, infrared and visible wavelengths may cause the temperature within the sphere or of an irradiated specimen to rise to levels far beyond what would reasonably be expected during the service life of the specimen. Conversely, with respect to ultraviolet wavelengths below about 290 nm, such wavelengths are not naturally observed, and it is therefore desirable to filter out such wavelengths when simulating exposure to natural sunlight. Accordingly, in the preferred embodiment of the invention, a filter **23** desirably is interposed between the light source **19'** and the integrating sphere **11**. The filter **23** may comprise, for example, an ultraviolet cutoff filter sold under the name WG 295 by Melles Groit or an interference filter sold by Barr Associates. In the preferred embodiment of the invention, however, the filter **23'** comprises a dichroic mirror **24**, as shown in FIG. **9**. Suitable dichroic mirrors are available from Oriel Corporation under the name Ultraviolet Long Pass Filters. Radiation from a light source **19'** includes a desired ultraviolet component as represented by arrow **25** and undesired higher wavelengths as represented by arrow **26**. Ultraviolet wavelengths **25** are irradiated onto the mirror **24**, and are reflected off of the dichroic mirror **24** and toward the integrating sphere **11'**. The undesired wavelengths **26** pass through the mirror **24** and are directed toward a heat sink **122**, which may comprise, for example, a solid block of copper. Other filters may be employed, for example, if it is desired to introduce electromagnetic radiation having wavelengths within a band of desired wavelengths into the integrating sphere.

With reference to FIGS. **2** and **3**, radiation (represented by arrows **22**) directed toward the interior cavity **21** of the integrating sphere **11** is reflected and re-reflected off of the Lambertian wall **12** until it exits the integrating sphere **11** through an exit aperture **14**, **15**, **16**. The integrating sphere **11** preferably includes a baffle **30** to prevent incoming light from exiting directly through one of the exit apertures **15**. The surface of the baffle **30** preferably is Lambertian or is coated such that the surface is rendered Lambertian. Plural baffles may be employed within the sphere if desired.

Radiation beams exiting the integrating sphere through one of the exit apertures **14**, **15**, **16** will have a width and a radiance that is substantially uniform over the width. In most or all cases, the radiance of the radiation beam will be uniform over a cross sectional area of the beam, and the radiance of plural beams of radiation exiting through similarly sized apertures will be uniform from beam to beam. When the radiation source is disposed externally with respect to the integrating sphere, as is preferred, it will be very easy to change the radiation source (such as by adding or removing ultraviolet bulbs) or to adjust the wavelengths of light that are permitted to enter the integrating sphere. If desired, a sensor (not shown) may be placed within the integrating sphere to monitor the radiation flux within the integrating sphere. When used, the sensor should be protected from direct irradiance from the light source, such as, for example, with a baffle interposed between the light source and sensor. If the radiation flux is observed to decrease or otherwise change over time, suitable compensation may be made in the radiation entering the integrating sphere. Extended irradiation of one or more specimens at constant irradiance over time thus may be achieved.

In accordance with the invention, a specimen is placed in radiative communication with the aperture of the integrating sphere such that radiation exiting the integrating sphere impinges on and irradiates the specimen. The specimen may be any tangible thing, and it is not intended to limit the invention to particular types of specimens that may be tested in conjunction with the invention. Ordinarily, a specimen will comprise a material that will normally be expected to be exposed to ultraviolet radiation. Such materials may include, for example, structural materials such as tensile fabrics, geotextiles, automobile tires, structural composite materials, asphalts, roofing materials, and so forth. Other nonstructural materials that may be tested in conjunction with the invention include materials such as coatings, nonstructural textiles, vinyl, plastics, paper, leather, nonstructural rubber and so forth.

Preferably, the specimen is irradiated for a time sufficient to cause a measurable change in a property of a specimen. Preferably, the specimen is irradiated with light having wavelengths ranging from about 290 nm to about 500 nm to thereby simulate the ultraviolet spectrum of natural sunlight and to thereby artificially weather the specimen. Many material properties are altered by electromagnetic radiation,